JPSS VIIRS SENSOR DATA RECORD (SDR)

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NOAA/NESDIS/STAR

Hurricane Lane
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Outline

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- Sensor/Algorithm Overview
- S-NPP/N-20 Product(s) Performance
- Major Risks/Issues and Mitigation
- Milestones and Deliverables
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- Summary

VIIRS SDR Cal/Val Team

PI	Organization	Team Members	Roles and Responsibilities
C. Cao	STAR		Team lead, calibration/validation, SDR science, coordination, oversight
S. Blonski / W. Wang	STAR contractor team	J. Choi, Y. Gu, B. Zhang, A. Wald	Flight & operations interface; maneuver support; VIIRS SDR cal/val (prelaunch studies; software code changes and ADL tests; postlaunch analysis, monitoring and LUT update; operations support; anomaly resolution); postlaunch cal/val tasks.
X. Shao/E. Lynch	UMD/CICS team	S. Uprety, Y. Bai, E. Lynch, and students	Precision lunar position for maneuver, DNB operational calibration, straylight correction, geolocation validation, intercomparisons, solar/lunar calibration; image analysis& quality assurance; postlaunch cal/val tasks, documentation.
I. Guch	Aerospace team	G. Moy, E. Haas, S. Farrar, F. Sun, and many others	Prelaunch/Postlaunch connection at vendor facility; independent analysis of special tasks.
J. Xiong	NASA/VCST team	G. Lin, N. Lei, J. McIntire, and others	Flight support, geolocation, postlaunch cal/val tasks; independent analysis,
C. Moeller	U. Wisconsin team	C. Moeller, J. Li	VIIRS RSR, CrIS comparison, DCC calibration
JPSS	JPSS team	R. Marley, C. Rossiter B. Guenther	Operations, collaboration

VIIRS SNR/NEDT Performance

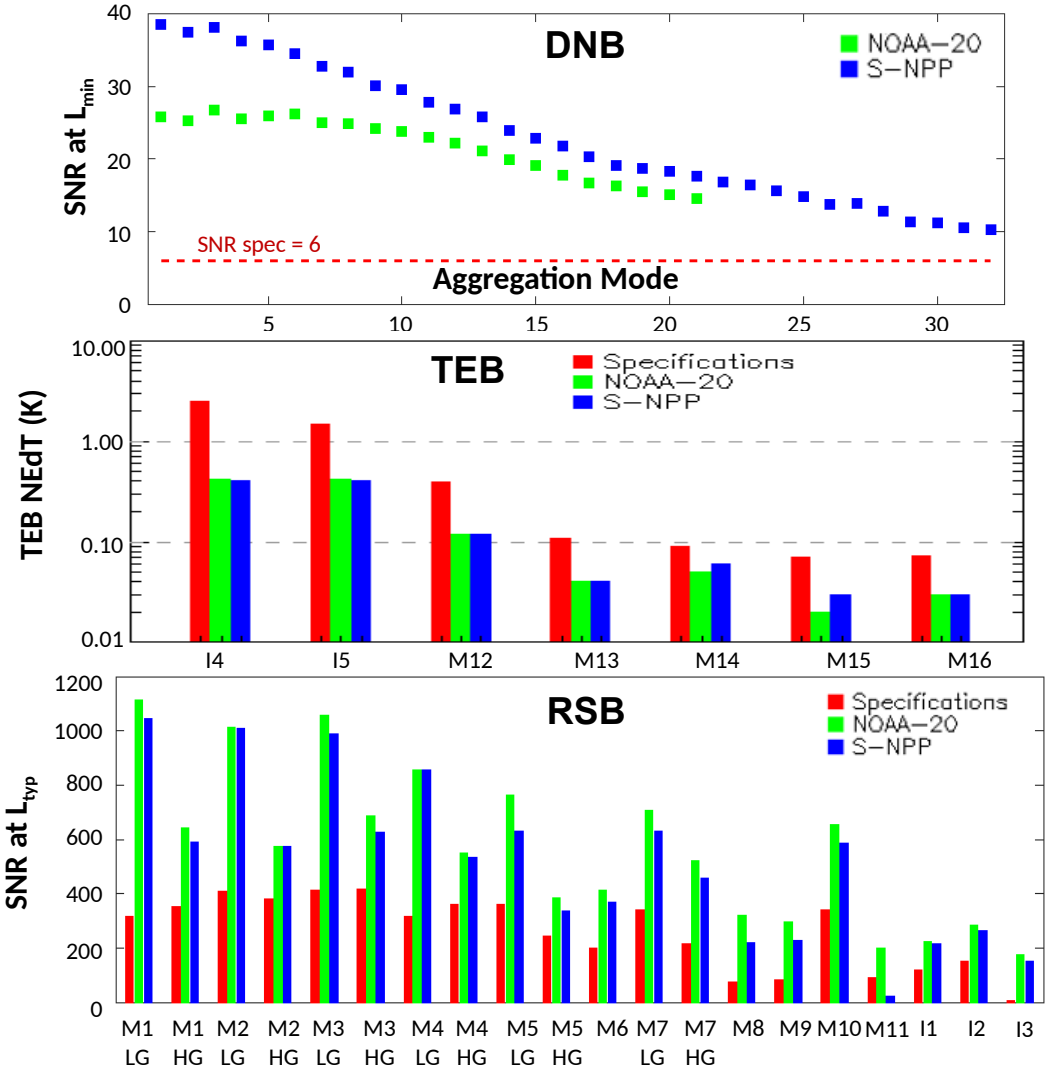
Band	L_typ	SNR Spec	NOAA-20 (on-orbit)	S-NPP (on-orbit)
M1 LG	155	316	1115	1045
M1 HG	44.9	352	644	588
M2 LG	146	409	1012	1010
M2 HG	40	380	573	572
M3 LG	123	414	1057	988
M3 HG	32	416	686	628
M4 LG	90	315	857	856
M4 HG	21	362	551	534
M5 LG	68	360	762	631
M5 HG	10	242	383	336
M6	9.6	199	413	368
M7 LG	33.4	340	708	631
M7 HG	6.4	215	523	457
M8	5.4	74	319	221
M9	6	83	297	227
M10	7.3	342	653	586
M11	1	90	198	22*
I1	22	119	224	214
I2	25	150	285	264
I3	7.3	6	174	149

Band	T_typ	NEDT Spec	NOAA-20 (on-orbit)	S-NPP (on-orbit)
M12	270	0.396	0.12	0.12
M13	300	0.107	0.04	0.04
M14	270	0.091	0.05	0.06
M15	300	0.07	0.02	0.03
M16	300	0.072	0.03	0.03
I4	270	2.5	0.42	0.4
I5	210	1.5	0.42	0.4

Band	L_min	SNR Spec	NOAA-20 (on-orbit)	S-NPP (on-orbit)
DNB**	3	6	>10	>10

* For S-NPP M11, L_{typ} = 0.12 W/m^2-sr-µm

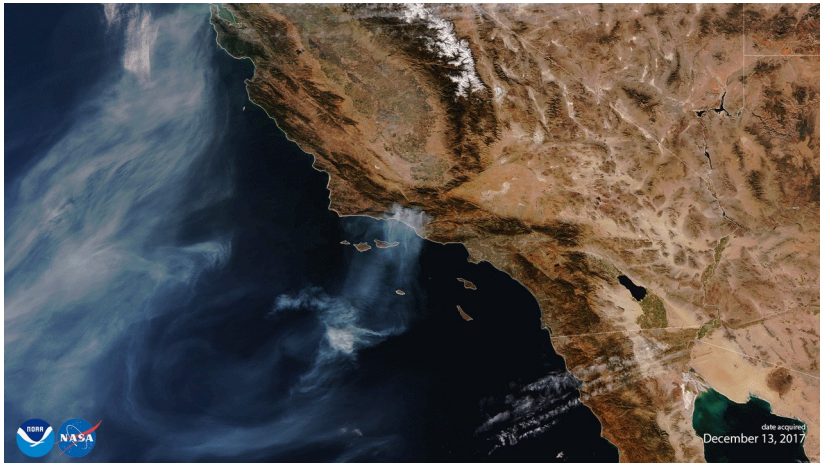
** On-orbit SNR of DNB at L_{min} was evaluated by using the DNB OBC-BB data



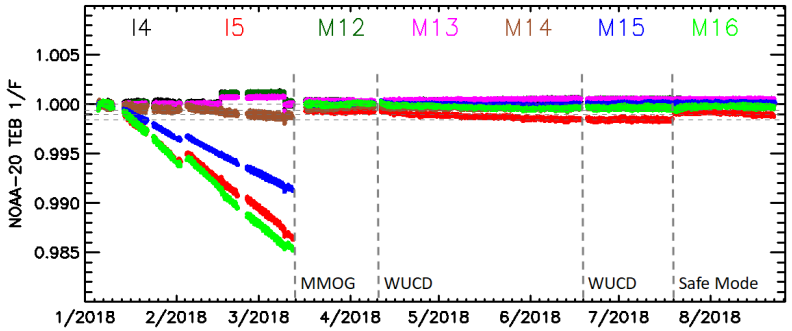
All channel noise performance meet specification, comparable to SNPP (I3 bad detector excluded)

FY18 Top Accomplishments

- NOAA-20 postlaunch investigation and mitigation of initial production of VIIRS SDR; Timely diagnosed and resolved ground processing anomaly to support the mission critical First Light Image.
- Prepared and performed NOAA-20 VIIRS Post Launch Test (PLT) tasks to ensure the quality of SDR; Development and deployment of updated LUTs to achieve Provisional and Validated Maturity of NOAA-20 VIIRS SDR as scheduled.
- Support monthly operational lunar calibration with precision lunar position predictions.
- Closely monitored NOAA-20 TEB performance and successfully supported LWIR degradation investigations.
- Post-launch evaluation and significant improvements of NOAA-20 VIIRS geolocation accuracy
- S-NPP VIIRS version 2 OnDemand reprocessing with the latest methodologies (annual oscillation mitigation in SD F-factors, Kalman filtering using DCC, SNO and Lunar F-factors).

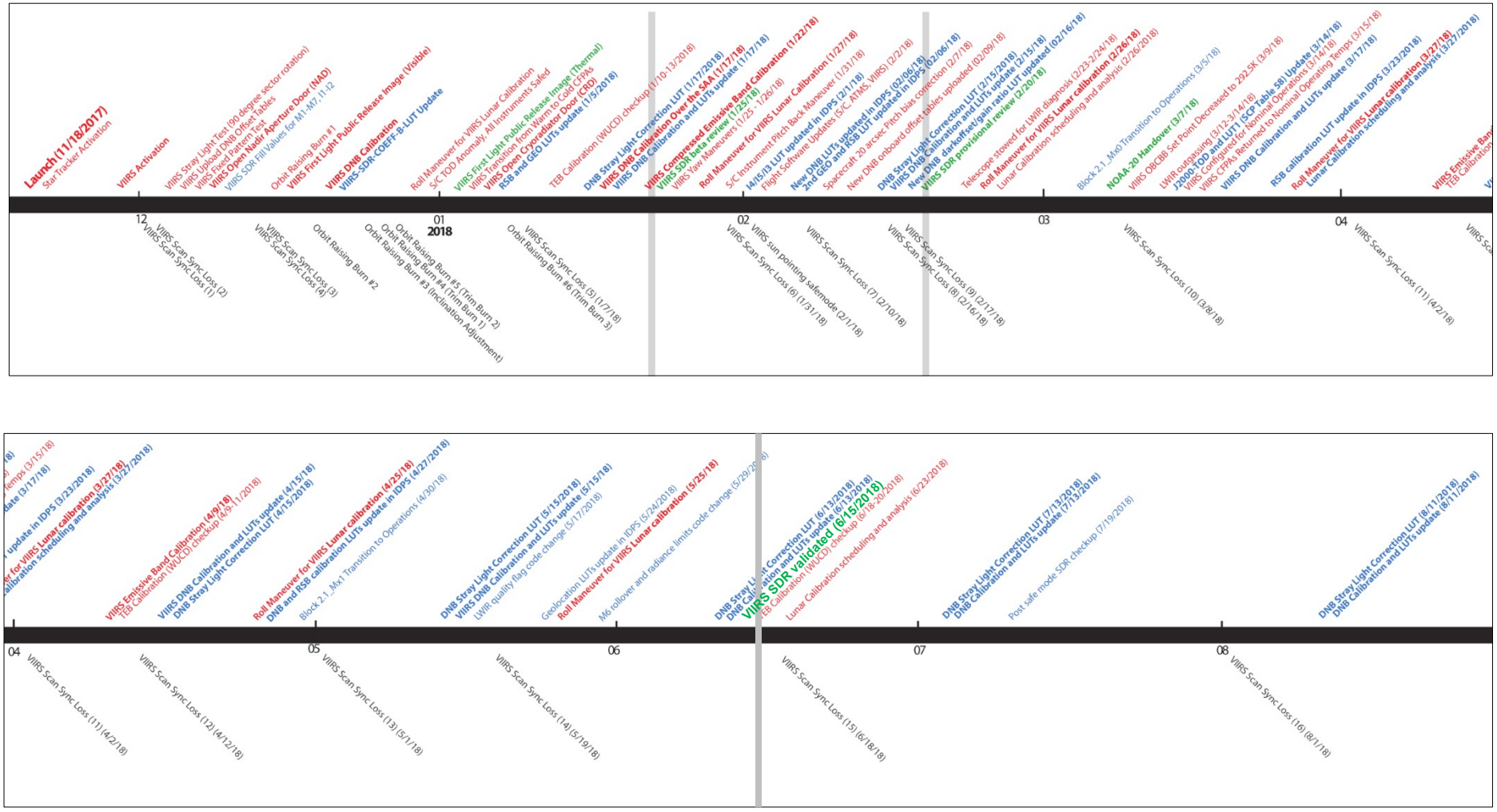


NOAA-20 VIIRS First Light Image



NOAA-20 VIIRS TEB LWIR Degradation

NOAA-20 VIIRS Events



Red= mission operation **Green= major milestone** **Blue= IDPS update**

VIIRS Performance and Error Budget

Attribute Analyzed	L1RD Threshold	Pre-Launch Performance	On-orbit Performance	Meet Requirement?	Latest results
RSB Bias	2%	2%	Most bands within 2% relative to SNPP (@Low latitude SNOs)	Yes, meet the +/- 2% requirement; Exceptions: M5, M7 (I2), (M4 atyp)	-N20 biased low by 2% for most bands compared to SNPP -N20 M5/M7 calibration are more consistent with other radiometers such as MODIS
TEB Bias	0.1K @ OBCBB	0.1K	<0.1K compared to CrIS during nominal operations	Yes.	-Bias during WUCD up to 0.05K. Recommended to reduce WUCD to annual. -Scan angle dependent bias under investigation (splinter meeting)
DNB Bias	5-10% (LGS) 10-30% (MGS) 30-100% (HGS)	4.4-6.5% (LGS) 7.6-9.0% (MGS) 10.5-54.2% (HGS)	4%±1.4% compared to SNPP DNB (LGS) 3.5%±5% compared to SNPP DNB (HGS)	Yes.	Calibration consistent with Suomi NPP

Note: DNB L1RD threshold and prelaunch performance are for aggregation modes 1-21, provided for 3 gain stages, at 0.5 *Lmax and low radiance for LGS, at high and low radiance levels for MGS and HGS.

Major Risks/Issues and Mitigation

Risk/Issue	Description	Impact	Action/Mitigation
N20 VIIRS RSB constant bias relative to S-NPP	NOAA-20 RSB calibration has a constant bias (2%) lower than that of S-NPP due to prelaunch characterization	Consistency for products requiring absolute calibration may be affected	- SMEs at Aerospace and NASA to investigate prelaunch characterization issues and recommend fundamental solutions (splinter session) - Closely monitor biases between NOAA-20 and S-NPP using multiple methods
M15/16 bias	M15/16 scan angle, and scene temperature dependent bias relative to CrIS	Affects accuracy at high scan angle and low temperatures	Further comparison and investigation
Sync loss	The loss of synchronization between the RTA and HAM occasionally	Loss of ~2 mins of data periodically	No fix except for future model improvements
N20 VIIRS RSB H-factor stability	Instability in H-factor due to uncertainties in SDSM may lead to calibration issues	Products requiring time series analysis may be impacted due to instability in early products	- Ideally more yaw maneuvers will be needed but that plan was not supported by operations. - VIIRS SDR team developed a new algorithm to reduce the uncertainties and it will further improve as more data collected over time.
LWIR degradation	NOAA-20 LWIR degradation unexpected due to water vapor	Longterm impact on noise performance	- Mid mission outgassing resolved this issue - Will closely monitor the performance

FY19 Milestones and Deliverables

Task	Description	Deliverables	Scheduled Date
Monthly Lunar, DNB calibration &straylight correction	Precision lunar position calculation for lunar maneuver; DNB VROP support, monthly; complete DNB straylight correction LUT development (monthly based)	Precision lunar position and DNB monthly calibration	Monthly
Geolocation LUT & code change to support J2	The encoder data was hardcoded in the operational code. This needs to be changed in both the LUT and code to make it work for J2	Operational code and LUT for all VIIRS	12/2018
TEB cal during lunar intrusion	Moon in VIIRS spaceview corrupts the calibration. The new algorithm fixes this problem.	Algorithm and code to operations	3/2019
Remove Obsolete LUTs	Some of the VIIRS operational LUTs are obsolete and need to be removed after an impact assessment	Updated operational codes &LUTs	3/2019
J2 TVAC RDR	Convert J2 TVAC data to RDR for testing	RDR data based on TVAC data	3/2019
J2 VIIRS LUT development	Develop VIIRS LUT based on prelaunch calibration	Initial version of J2 VIIRS LUT	6/2019
Intercal web site	Develop a website for intercal between VIIRS and ABI following GSICS standard	Website	9/2019

User Feedback and Summary

Name	Organization	Application	User Feedback - User readiness dates for ingest of data and bringing data to operations
Andy Heidinger	STAR/UW	Cloud Mask	Positive feedback on NOAA20 M5/M7
Menghua Wang	STAR	Ocean Color	Ocean view website: https://www.star.nesdis.noaa.gov/sod/mecb/color/ocview/ocview.html#date=20180607/zoom=2/lat=0/lon=0/tc=true/l2=true/sens=VIIRSJ1/proj=4326/algo=noaa_msl12_nrt/prod=chl/ave=daily/cbar=false/gran=false/coast=true/grid=false
Tom Atkins/Lihang Zhou	STAR	Alaska Watch	Alaska watch website: https://www.star.nesdis.noaa.gov/jpss/alaskawatch/
Alex Ignantov	STAR	SST	SST website: https://www.star.nesdis.noaa.gov/sod/sst/micros/#
Ivan Cisiszar	STAR	Fire	Fire website: http://viirsfire.geog.umd.edu/map/map_v2.php
Don Hillger	STAR/CIRA	Imagery	Presentation later
Eric Steven	Alaska/GINA	Operational user	http://feeder.gina.alaska.edu/
Shobha Kondragunta	STAR	Aerosol	IDEA website: https://www.star.nesdis.noaa.gov/smcd/spb/aq/index.php

VIIRS Reprocessing

S-NPP VIIRS V1

- **Consistent IDPS baseline calibration using the latest algorithms and LUTs**
- Introduced "bias correction" term to produce OC equivalent SDR as an option; also correct M5&M7 biases
- Thermal band improvements to address saturation and WUCD bias for selected bands
- DNB consistent calibration for all gain stages, less negative radiances, consistent terrain correction
- Geolocation improvements with consistency

S-NPP VIIRS V2 (supersedes V1)

- **VIIRS SDR final baseline calibration**
- Future improvements only require bias correction, instead of reprocessing
- Calibration oscillation correction based on SDSM and BRF physics, instead of smoothing
- Calibration based on STAR VIIRS SDR team's Kalman filter model F-factors, which reconciled Lunar, DCC, SNO calibrations.
- Other improvements (IDPS code correction)
- Official version for NECI archinve

On-Demand Reprocessing

Why?

- VIIRS data volume is large (~1 PB/7 years) There is not enough storage space; NCEI is not yet ready to take the data
- SDR volume is 10x of RDR
- Generating SDR files on the fly is faster than transmitting over the network
- Most users don't need all the data (few have the storage capacity

How?

- Work with specific users to define needs
- Generate the required SDRs only when needed
- User can define spatial and temporal criteria
- SDR can be either generated at STAR or user site
- Will provide fully reprocessed SDR to NCEI when they are ready to accept
- Demonstrating for N20 DNB, and Calibration site data for GSICS

For more details, attend three reprocessing talks at this annual meeting

Future Plans/Improvements

1. Continued monthly Lunar calibration support
2. Continued DNB straylight LUT development
3. Continued vicarious monitoring using DCC, cal/val sites, and geolocation
4. Collaborate with GRAVITE reprocessing early NOAA-20 data; continue developing the OnDemand reprocessing capabilities; establish interface with NCEI/CLASS
5. Contribute to the NASA technical book Volume VIII
6. Possible field campaign: VIIRS DNB SI traceable calibration in collaboration with SDSU and USGS calibration center. Leverage light source developed under NOAA SBIR
7. J2 prelaunch calibration support; LUT and test data development

VIIRS Science Team will continue providing operational cal/val support.

Summary

- STAR VIIRS SDR team has developed full capabilities to support VIIRS calibration/validation, as demonstrated in the NOAA-20 VIIRS postlaunch support.
- Precision lunar prediction is the latest addition to the STAR capability supporting monthly lunar maneuver for mission operations
- Both NOAA-20 and Suomi NPP VIIRS are performing well as expected; the team has identified and will address remaining issues, working closely with users, vendors, and the flight project
- As reprocessing is becoming more mature, more efficient strategies are being developed to meet user needs while optimizing computing power and storage
- In addition to the continued NOAA-20 and Suomi NPP VIIRS support, the VIIRS SDR team is ready to support J2 VIIRS

Backup Slides

- Backup slides

NOAA-20 VIIRS Major Events

- Nov 28, 2017: instrument turn on
- Nov 30, 2017: first SDSM operation
- Dec 08, 2017: first electronics self-test (Ecal)
- Dec 13, 2017: nadir aperture door (NAD) open
- Dec 18, 2018: first DNB calibration (VROP)
- Dec 29, 2017: first lunar calibration (roll maneuver)
- Jan 03, 2018: cryoradiator door open
- Jan 10, 2018: first BB WUCD
- Jan 25, 2018: calibration yaw maneuvers
- Jan 31, 2018: calibration pitch maneuver
- Feb 21, 2018: rotating telescope stow (3 days)
- Mar 12, 2018: mid-mission outgassing.